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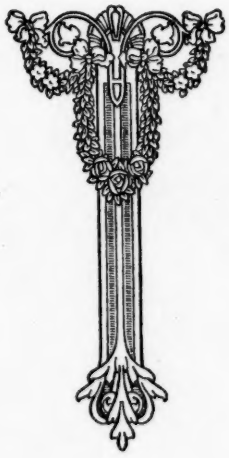

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Exercise Therapy in Relation to the Toxic Effects of Streptomycin

MURRAY CHRYSTAL, MURRAY APPEL, JOHN METZ

Corrective Therapists

Veterans Administration Hospital, 130 West Kingsbridge Road, Bronx 63, New York

During the interval from December, 1946, to June, 1947, 25 patients with renal tuberculosis were treated with streptomycin at this hospital. The daily dosage was 1.8 grams and was given in divided doses every four hours by intramuscular injection for approximately 120 days. Before treatment was instituted, the patients were subjected to a vestibular examination in order to make certain that the vestibular apparatus in each case was intact. The toxic effects on the vestibular apparatus became apparent in one case in less than two weeks after therapy had begun and by the 88th day, all the patients except one, had developed disturbances of equilibrium. This clinical finding was corroborated by the results of the caloric tests which were performed at regular intervals throughout the streptomycin regime.

These disturbances were manifested by the following: inability to walk a straight line, to pick up an object from the floor without losing equilibrium, to maintain balance with the eyes closed, to ascend and descend stairs with the eyes open without losing equilibrium, to walk in the dark, to produce deviation of the eyeballs without vertigo, to hyperextend the neck without the loss of equilibrium, to partake in any activity involving stooping, stretching and aiming, to change from sitting to standing and turning around to sit down again in a normal fashion. In short, these patients were unable to execute those functions which are an integral part of the daily physical demands of life.

After completion of the streptomycin thereapy, every patient was again subjected to a vestibular examination and results indicated damage to the vestibular apparatus. The test was repeated several times and the results were the same, namely, that the damage to the vestibular apparatus remained.

The psychological impact of the loss of equilibrium produced a deep emotional disturbance in some of the patients, particularly the older ones. Many refused to get out of bed for fear of falling, a few felt that they would never be able to return to their occupations.

All the patients were referred to the department of Physical Medicine Rehabilitation for this disturbance and under the guidance of the physiatrist in charge of the renal tuberculosis program and the renal tuberculosis service, a series of exercises were devised to enable the patients to compensate for the defect within the vestibular apparatus.

The exercises are as follows:

1. Eye movements, at first slow, then quick.
   (a) Up and down.
   (b) Side to side
   (c) Focusing on finger moving from three feet to one foot towards the face.
2. Head movements, at first slow, then quick, eyes open and later closed.
3. Shoulder shrugging and circling.
4. Standing with feet together with the eyes closed.
5. Changing from sitting to standing position with the eyes open and shut.
6. Throwing a bean bag from hand to hand above eye level.
7. Throwing bean bag from hand to hand under knee.
8. Change from sitting to standing and turning around to sit down again.
9. Individual in circle keeps turning to throw large ball to those around him.
10. Walk across the room with eyes open and then closed.
11. Walking towards an object on the floor with eyes open and then closing eyes, stooping to pick it up.
12. Walk up and down steps with eyes open and then closed.
13. Any activity involving stooping and stretching and aiming, such as basketball.

In order to chart the daily progress of

the patients participating in the exercise program a form (Figure 1) was developed with a rating scale from zero to three. Zero indicates vertigo with loss of equilibrium, one indicates vertigo without loss of equilibrium, two indicates loss of equilibrium only and three indicates a normal response: The patients were treated once daily and were advised to continue the exercises several times throughout the day. Progress in the restoration of equilibrium was noted in some cases within the first four days of therapy. Most of the patients were able to walk up and down steps with the eyes open after one week. On the whole, there was adequate compensation for activities that were accomplished with the eyes open within the first two weeks of the exercise program. The greatest difficulty every patient faced was in the performance of an activity with the eyes closed. At the end of a two-week period, only one patient could ascend and descend a series of 16 steps with the eyes closed. More than half the patients succeeded in this task at the end of a three-week period. The remainder were not able to perform this task during their entire hospital stay. The same results were obtained in the other activities where the eyes were closed. It is also interesting to note that on the whole the younger patients performed better and compensated sooner than did the older patients.

DISCUSSION

Arthur S. Abramson, M.D.
Assistant Chief, Physical Medicine Rehabilitation Service
Veterans Administration Hospital
Bronx 63, New York

The authors' article on the value of certain types of exercise compensating for the disturbances of the vestibular apparatus due to streptomycin therapy is, I believe, a very valuable contribution in the field of Corrective Therapy. I have had the opportunity of helping them in this work and of evaluating their results. They are careful to use the term compensatory when attempting to interpret what the exercises are truly doing. We have absolutely no conception at the present time as to why these patients improve. That they do improve is unquestioned. Their disability had been stationary for approximately six months prior to the institution of exercise therapy. The vestibular apparatus was tested following their improvement and was found to be unchanged. That the exercise has a retrograde action on the vestibular apparatus is highly questionable and must be in our present state of knowledge discarded. This group of 25 patients was the first to receive streptomycin therapy for renal tuberculosis in this hospital. Of this group only one did not develop disturbance of the vestibular apparatus. This was attributed to the large dosage of streptomycin which these patients received, consisting of two grams a day for 120 days. It has since been observed that smaller dosages reduce the severity and perhaps the incidence of these disturbances. Streptomycin is now given at the rate of one gram a day for 42 days. At this time, the exercises are started at the onset of streptomycin therapy on the theory that if they have corrective value long after therapy they may have some prophylactic value during therapy.

Harry Kessler, M.D.
Chief, Physical Medicine Rehabilitation Service
Veterans Administration Hospital
Bronx 63, New York

The toxic reactions of any given medication may well determine the part which it will play in the treatment of a pathologic process. It is obvious that no matter how efficacious a form of therapy may be in a pathologic process, if such therapy becomes associated with severe toxic manifestations, it may result in such serious limitations of its use as to relegate it to that category of therapy wherein it may be stated that the cure is worse than the disease itself.

Although the toxic manifestations of streptomycin have not reached the magnitude which would prohibit its use, experienced observers have nevertheless consistently reported certain deleterious effects following prolonged administration, and recommendations for careful selection of patients for streptomycin therapy and for modification of dosage have followed in due course. One of the most disturbing of the toxic manifesta-

tions observed has been a derangement of the vestibular apparatus with consequent vertigo, loss of equilibrium, or both. The effects that this disturbance has had from both a physical and mental standpoint have been well described in the paper presented and it becomes readily apparent that a form of therapy capable of producing such damage must be approached with considerable caution.

The role of Corrective Therapy in the amelioration of these toxic manifestations has appeared to offer a most important contribution to our experience with streptomycin therapy. However, it is well to remember that despite the encouraging results described, until we can appreciate exactly what has been accomplished, until we can know why this remarkable improvement has taken place, we should proceed with caution in any claims which we may be tempted to make. The number of cases so far treated is still relatively small; furthermore, we are not yet fully aware of the degree of permanence of the recoveries which we have been pleased to observe. Only by continued attentive observation over prolonged periods of time and by careful scrutiny of the results of such Corrective Therapy procedures as have been instituted will we ultimately be in a position to place a more correct evaluation upon this method of approach. Meanwhile, I would like to take this opportunity of congratulating the authors of this presentation upon their conscientious efforts, their technical skill and upon their close cooperation with the medical staff.

Seymour Shore, M.D.
Renal Tuberculosis Section
Veterans Administration Hospital
Bronx 63, New York

The therapeutic exercise program instituted by the Corrective Therapy Section of this hospital for the amelioration of the toxic effects of streptomycin therapy for renal tubercular patients has definitely been a contribution to the restoration of equilibrium in these patients. At the present time, it cannot be explained why these exercises accomplish these effects, but clinical evaluations of the patients receiving this therapy have shown improvement.

Throughout the course of treatment, the staff of the Corrective Therapy Section has cooperated in every extent. They have discussed each case at various intervals with the physicians in charge of the ward, and have manifested great interest in the progress of each patient.

FIGURE I

Rating scale to chart progress in patients with vestibular disturbances due to streptomycin therapy:

Observations & Findings of Corrective Therapy Activities in Relation to Toxic Effects on the Vestibular Apparatus Resulting From Streptomycin Therapy.

Activity Tested

1. Eye movements
2. Head movements
3. Shoulder shrugging and circling
4. Bending forward and picking up objects from ground
5. Change from sitting to standing and turning around to sit down again with eyes open and shut.
6. Throwing bean bag from hand to hand above eye level.
7. Throwing bean bag from hand to hand under knee
8. Patient in circle keeps turning to throw large ball to those around him
9. Walking across room with eyes open and shut
10. Walking towards an object on the floor with eyes open and then closing eyes, stooping to pick it up
11. Walking up and down steps with eyes open and shut
12. Any activity involving stooping and stretching such as basketball

Rating Scale

0. Vertigo with loss of equilibrium
1. Vertigo without loss of equilibrium
2. Loss of equilibrium only
3. Normal response

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Physical Medicine Rehabilitation From the Viewpoint of Corrective Therapy and Adapted Sports

GEORGE T. STAFFORD

National Consultant in Corrective Therapy, Physical Medicine Rehabilitation Service V. A.
National Consultant in Physical Reconditioning, the Surgeon Generals Office, Dept. of the Army

Tuberculosis Rehabilitation Seminar, Legion, Texas, September 29, 1948

The papers which have been given and the demonstrations which I have witnessed at this Tuberculosis Rehabilitation Seminar are indicative of definite progress in the treatment of the patient with tuberculosis. Not only is the patient receiving the benefits of the newer methods of treatment but the patient is conceived of as a personality whose recovery is dependent upon a feeling of security, a knowledge that when his disease has been controlled he can look forward to a useful, purposeful, happy life as a contributing member of society. How does CORRECTIVE THERAPY fit into the newer method of treatment?

I am assuming that my audience is receptive to the thesis that there is merit in exercise during convalescence, as an adjunct of therapy in many cases of illness or injury. World War II has frequently been given as the starting place for the use of exercise or activity as an adjunct of therapy, but we all realize that many physicians have advocated and used activity as a form of therapy long before World War II. World War II did, however, give the needed emphasis to the use of medically prescribed activity as a form of therapy. The need for additional hospital beds, the doubts of many medical men as to the therapeutic value of bed rest, and finally the acceptance of physical or restorative medicine as an adjunct of therapy and a part of planned purposeful recovery, all helped to focus attention on activity as a valuable form of therapy. The experiences of the Armed Forces Re-conditioning and Rehabilitation programs and the scientific investigations of many medical men gave further proof that rest as a therapeutic measure is not only undesirable as a therapeutic measure, but in many cases, is actually fraught with hazard.

There are however certain **conditions for which rest is definitely indicated.** Some of these are:

Cases in which there is need to reduce the demand exacted by physical exertion on the cardiovascular and respiratory systems which have been rendered incompetent by disease and which may be further embarrassed by muscular effort.

Cases in which there is the necessity for repair of infected tissues.

Cases which demand rest to cure inflammatory and destructive diseases of joints.

Cases in which there is need to eliminate pain and alleviate distressing symptomatology and anxiety referrable to physical movement.

Cases in which it is necessary to maintain immobilization of healing surfaces. In many of these cases exercise may be indicated for the unaffected parts.

Cases in which it is necessary to allow rest for the purpose of arresting hemorrhage or preventing its recurrence.

There are certain **unfavorable results of rest** which should be avoided, such as vasomotor instability as seen in tachycardia, loss of endurance and postural hypotension, phlebothrombosis, pulmonary embolism, hypostatic pneumonia, myasthenia, arthritic exacerbation, etc. The decrease in metabolic function and the subsequent nutritional disturbances as well as the loss of chemical balance may be added to the list of sequelae of bed rest. The tuberculosis patient should be receiving good nourishment. As the disease responds to treatment one might question whether "absolute" bed rest improves metabolic function.

Numerous studies have shown that bed rest of even one or two weeks results in a marked loss of muscle tissue and muscle tone, especially of the quadriceps, the gluteals, the abdominals and the foot and leg muscles. Obviously, when the patient is in the acute stage of tuberculosis the pathological phase must receive first consideration, even at the expense of loss of muscle tone. But, when the disease is no longer active and the

patient is soon to assume a sitting position for ten minutes, can we overlook the need for muscle tone to support the body in the sitting position without causing undue strain on the muscular and cardio-respiratory systems? How can we recondition the patient so that he can assume the sitting position without any exacerbation of the patient's condition?

Finally there is the psychic invalidism which accompanys enforced bed rest. There is a stultifying effect of being forced to remain in bed and to be assisted in all the simplest personal needs which definitely lower one's morale.

Activity is now accepted as a form of therapy in many cases of illness or injury for which in the past bed rest was definitely indicated. Karpovich's work with rheumatic fever cases shows a reduction in the length of time spent in bed and an increase in the patient's physical capacity where carefully prescribed exercises were used **after** the acute condition had subsided. Brain surgery does not present the many thrombotic hazards where early ambulation is used that it formerly presented when the patient was allowed, or rather required, to remain in a state of inactivity very close to coma.

Numerous other well-known examples of the acceptance of exercise during convalescence are familiar to all of this audience. The obstetrician regards the post-puerperium period as the time for regaining strength through carefully prescribed activities which stimulate the circulation, assist in the removal of waste products and definitely aid in toning the affected parts. The orthopedist has for years been using exercise of the unaffected part to promote more rapid healing of the affected bone or joint.

In spite of the general acceptance of exercise as a form of therapy **many physicians are reluctant to use "exercise" in the treatment of the tuberculous patient.** This conservative attitude is natural in the field of healing. Pasteur was first shunned by his colleagues, as were many other pioneers of medicine. But, exercise before and after thoracoplastic surgery is now accepted practice with most surgeons. The activities of Occupational and Physical Therapy have been accepted by most of our doctors who are treating the tuberculous patient. Doctor Hibbard has subscribed to recreation during certain phases of the patient's convalescence. Dr. Winiker mentioned Dr. Levine's use of exercise for patients with tuberculosis. The work which is being done at Swannanoa, North Carolina, is too new to more than mention it, but in addition to the consideration of the actual pathological condition considerable emphasis is given at Swannanoa to the social and the economic phases of the patient's total rehabilitation. Fitzsimmons General Hospital at Denver has a physical reconditioning program for its patients whose recovery has reached the stage where they are soon to begin their periods of sitting in bed. Has exercise or corrective therapy a place in the recovery stage of the patient's convalescence?

For the doctor who prescribes "absolute" bed rest for his patient one might well raise the question as to whether this condition is possible. **Really there is no such thing as absolute rest for the body.** The vegetative system functions until it is stopped by death. What the doctor is striving for is a minimum of activity. The doctor's prescription of inactivity meets the resistance of the patient's natural desire for activity. This desire or urge, which is natural in all beings, must have a certain degree of satisfaction or frustration results. One of the doctor's most serious problems is to prevent the patient from engaging in activity.

It might be well to raise the question as to whether we can direct the patient's natural urge for activity into a minimum of planned purposeful activity which, while not disturbing the affected part, will prevent deconditioning of the unaffected parts of the body. Some progress along the line of activity has been made in allowing patients to participate in occupational therapy activities. What figures have we as to the energy cost expanded in leather work, basket weaving and the like? These activities are obviously valuable from the point of the patient's morale. Creative writing has been offered as a type of activity for the convalescent patient. The average American does not read enough good books. Cultural activities such as the above can be highly recommended for all of us, including the patient. But, many patients may not become enthusiastic about puppetry and bedside gardens. **What would**

be the energy cost expended in exercises which would prevent deconditioning of the muscles of the feet, the quadriceps muscles and the pelvic muscles which are so important for maintaining good posture?

Mention has been made of the need for good bed posture. Correct body alignment while the patient is in bed will help, but better results will come when the patient's posture muscles are kept in good tone. Tone is a by-product of exercise. Mrs. Alterman of Alexandria has given an excellent demonstration of the activity which accompanys and results in relaxation. **Activity to produce relaxation is planned purposeful activity,** but it is activity. The patient with tuberculosis who should be engaging in a minimum of activity should be taught how to relax and thus prevent the frustration which comes when one is told to lie quietly when his inner urges are shrieking for activity.

Considerable emphasis has been given to the word INTEGRATION during this seminar. Integration is essential in the treatment of the patient with tuberculosis. It is not enough for the surgeon to perform chest surgery and give little or no concern for the patient's postoperative posture. The work of the Manual Arts Therapy department tends to satisfy the patient's desire for economic security. The Chaplain offers a very important service in the patient's recovery when the spiritual life of the patient is made more secure. In addition to caring for the patient's pathological needs integration means that we also consider his social, economic, mental, emotional and spiritual needs. To carry this thought one step farther we should all take an active part in the work which National Tuberculosis Association is doing in an attempt to PREVENT tuberculosis. A chest X-ray for everyone at least once every twelve months would be a step in the right direction; supporting adequate legislation for commitment is the duty of every citizen; more functional health education in the schools with special emphasis on preventing tuberculosis thru case-finding would make integration more than a mere verbal expression. And as a further thought we might consider the possibilities of exercise as a form of therapy for the patient with tuberculosis, even though it is something new. Let us not as Elbert Hubbard said, "Be down on those things which we are not up on."

What is the energy cost of exercise? Karpovich in the ARCHIVES OF PHYSICAL MEDICINE for July, 1947, offers some interesting data on energy cost of exercises. He defines energy cost as the oxygen consumption expressed in multiples of the resting metabolic rate. Raising one leg from the supine position costs 2.5 over the resting rate. Drawing the knee to the chest from the supine position shows an energy cost of 3.2, the ordinary "dip" or push-up shows a cost of 6.5. The energy cost expended through exercise can be measured. Rather than decrying the possible benefits of planned, purposeful activity we should plan the much needed research to determine just how much energy the patient would be expending in performing activities which would be valuable in preventing deconditioning. Perhaps at this point it might be well to emphasize the fact that corrective therapy is not interested in the development of huge muscles, nor the furthering of athletic accomplishment such as proficiencies in the more vigorous sports such as basketball or boxing. **Corrective therapy is interested in improving or maintaining muscle tone in order that the patient can use his body with greater** mechanical and organic efficiency. I would like your reactions on the following order of exercise for the tuberculosis patient:

To prepare the patient to assume the sitting position the following exercises should be performed two or three times each at the beginning of each waking hour:

1. Plantar and dorsi flexion of the feet to strengthen the arches.
2. Draw the abdomen in and tighten the gluteal muscles.
3. Stretch the arms out to the side shoulder level and contract the rhomboid muscles.

Each exercise is done slowly and a short rest is taken between each exercise. When the above exercises can be performed without elevation of pulse rate ten or more per minute above pre-exercise rate taken two minutes after exercise, without evidence of dyspnea or

cyanosis, and without subsequent rise in temperature, the patient should be ready to perform the following series six times for each exercise at the beginning of each waking hour:

1. Draw the abdomen in and tighten the gluteal muscles.
2. With elbows bent, press elbows into the mattress and raise the chest.
3. Pull first the right knee and then the left knee toward the chest.
4. With hands above in line with body, stretch first the right side of the body and then the left side of the body.

When the above series can be performed without any untoward effects and the patient is allowed up from 15 to 30 minutes daily the following exercises may be performed twice daily using six to eight repetitions for each exercise:

1. Drawing in of the abdominal muscles and tightening the gluteals.
2. Stretching the arms from toward the ceiling to the side shoulder level.
3. Lying with the knees bent, raising the hips and swaying first to the right and then to the left.
4. Plantar and dorsi flexion of the feet.
5. Lying on the back, drawing alternate knees toward the chest.
6. Lying on the back, flexing and extending the wrists.
7. Raising the body to a sitting position.
8. Lying on the back with the elbows bent and the fists resting on the chest. From this position stretching the elbows away from the body as though one were breaking a piece of string.
9. Simple breathing exercise.

Activities given above and performed slowly, with adequate rest between each different exercise movement would condition the patient for ambulation, his posture muscles would be in better tone, as would his vasomotor system. Ambulation with short walks would not cause undue fatigue of the skeletal system—the body would be used more efficiently and with less strain. Finally, the patient would get that mental "lift" which comes when one has accomplished a worthwhile task.

As calesthenic exercises eventually become monotonous the **use of sports, which can be adapted to the patient's needs,** has been advocated for the **advanced convalescent.** But, these sport activities must be prescribed by the medical doctor. It must also be borne in mind that the purpose of these sports is NOT that of developing physique; the purpose is to further social and emotional benefits and to teach the individual skills in safe sports which he can engage in during his leisure. No doubt many recurrences have been due to patients engaging in undirected sports which were beyond his capacity. His rehabilitation training in the hospital should include guidance in those sports which will not tax his energies. He must learn that **moderation must be the keynote for all his activities.** He must finaly realize that he still can enjoy life and maintain his health through lighter forms of recreational activities. It might be well at this point to de-emphasize golf as a form of activity too frequently engaged in when the weather is unduly hot and which causes a great deal of unnecessary fatigue, which the patient must avoid even after his condition is arrested.

Corrective therapy and adapted sports can be used to measure one's physical (work) capacity. We must be concerned as to whether the patient is in condition to leave the hospital well enough to engage in gainful employment which is within his capacity. Has he the tolerance to perform the required activity of an eight hour job. Four hours work capacity is not enough to enable him to do an eight hour job. We must consider the economic phase of the patient's rehabilitation. Through exercises and adapted sports one can increase the patient's endurance for work.

Finally there is need for a **careful evaluation of our work** with the tuberculosis patient. What is he accomplishing? The use of "What's My Score?" in the Veterans Administration hospitals has been very helpful for the transverse myelitis case and for the amputee. A similar chart might help the tuberculosis patient chart his progress from the time when he is first able to take care of his simple body needs until he reaches the stage where he is able to walk three miles in one hour, six miles in two hours, or even twelve miles in three hours.

In conclusion let us view the patient from all angles. What can we do to prevent general deconditioning, to promote

a physical fitness which may help him maintain good resistance, to fit him to once again become a contributing member of society? How can we better promote his resocialization than to send him from the hospital with a confidence in himself, with a feeling that he is needed, that he is wanted, that he belongs? With the restoration of his health and the feeling of security which comes with health and the knowledge that he can live a normal life the discharged patient should be better able to adjust himself to his environment. It is our privilege to be a part of the "team" which recognizes the patient as the one whose recovery is of paramount importance. Our task is to work harmoniously with other members of the team, not for our personal gain, but for the good of the patient. True integration and patient recovery comes when we are so busy working as a team that we have no time to waste in considering to whom belongs credit for the patient's recovery.

Some Preliminary Notes On the Use of a Motor Driven Ergometer in the Treatment of Neuropsychiatric Patients in Connection With Milieu Therapy[1]

RICHARD L. HARRIS, M.D., Chief Medical Officer
HARRY W. HART, A.B., Assistant Chief Corrective Therapy
HAROLD J. BRENNER, B.S., Corrective Therapist
Veterans Administration Neuropsychiatric Hospital, Los Angeles

Early in January, 1948, the Corrective Therapy Department of the Veterans Administration Neuropsychiatric Hospital at Los Angeles, California, began a research project to determine the effectiveness of a motor driven ergometer in the treatment of neuropsychiatric patients. The Human Engineering Foundation, represented by Mr. Blake Snyder, furnished four machines for this purpose.

For the purpose of assembling data to prepare this report the observations and impressions of 11 Corrective Therapists working with a total of 92 patients covering 11,040 treatments over a period of 10 months were used. The patients chosen for treatment on the Exercycle were those who could not be induced to take part in any other activity.

Because of the fact that controlled experiments had already been conducted to show that the Exercycle provided muscular exercise,[1] [2] it was decided to approach the problem strictly from the psychiatric point of view. Although the experiment was thus psychologically oriented, there were so many patients treated who had real physical disabilities that psysiological aspects were much in evidence. It was felt, however, that the contribution we could make along purely psychological lines would be of more value and because of limited time and personnel we decided to proceed strictly along those lines.

The Corrective Therapy program is based on individually prescribed treatment aims and attitudes which are calculated to create an environment to meet the needs of the patient from a psychological point of view. The activities presented are physical but in most cases the actual physical development that might accrue from the activities is of least importance in the total treatment. It is the ATTITUDE of the therapist, both general and specific that produces the milieu which the doctor had prescribed. The activities are used merely as tools to provide opportunity to be in contact with the patient. The main problem, therefore, is to find an activity of a physical nature that will be acceptable both physically and mentally by the patient.

Mental patients present a great problem along the line of motivation. Some will enter into any type of physical activity with great gusto and seem to derive much satisfaction and psychic benefit from it. Some have so withdrawn from the world of reality that they will not enter into any activity. Others are in such

poor physical condition that they cannot participate in any activity consistent with their degree of sophistication. For instance, an elderly patient who cannot perform any type of accepted exercise and considers simple activities beneath his dignity, will accept the Exercycle without question.

It is to meet these problems that Corrective Therapy is searching for activities that can be used to provide the therapist an opportunity to have intimate contact with the patient and thus be in position to create the prescribed atmosphere or environment. The Exercycle, or a similar type machine, seems to provide such activity. It is complicated in appearance and seems to make a favorable impression on the patients. They feel that an extra-special type of treatment has been designed just for them, and it gives them a feeling of confidence that their particular trouble has received some thought. To perform on the machine is well within the abilities of most of the older patients as well as the young regressed catatonic types of schizophrenia.

The specific exercises used in the experiment were taken from the Exercycle Corporation's instruction manual.[3] The primary exercise progressions were brought about by readjustments of the handle bars and disengagement of the pedals from the electric power. The time element ranged from 3 minutes to 30 with an average time of about 15 minutes. It was thought desirable to lengthen the time as rapidly as possible due to the fact that the longer the therapist could be with the patient the more effective would be the attitude to therapy. The exercises were given regularly once a day through the five day work week.

The Therapeutic Aims have been simplified by the Physical Medicine Rehabilitation Service to five main types: Relief of Guilt Feelings; Narcissistic Gratifications; Acceptable Expression of Aggressions; Vocational Adjustment, and New Skills and Hobby and Activity Interest.[4] It may seem inconsistent to expect the same activity to meet such different objectives, but it must be kept in mind that it is not the activity itself but the ATTITUDE of the therapist as prescribed by the physician which provides the desired milieu during treatment.

To meet the treatment aim of Narcissistic Gratifications the exercises were changed at intervals to give the patient the impression that he was progressing. The "Success" factor was emphasized by the therapist in his conversations with the patient. Although the patient in many cases did not speak, as in the case of the mute, and otherwise regressed catatonic patients, it was felt that he derived some satisfaction and gratification. In-as-much as the newer position was only slightly more difficult it is to the credit of the machine that it was possible to simulate with any degree of success an actual progression in difficulty.

In the case of administering therapy to meet the aim of Relief of Guilt feelings the positions were not changed. It was thought that the need for monotonous activity to achieve the desired milieu was secured by this means. The patient, in this category, was not complimented nor given any kind of a "build up" but was given the exercise in a matter of fact manner and his pleas were disregarded. However, all through the treatments an underlying FRIENDLINESS was maintained at all times.

To summarize it was thought not to be of great importance as to what position was used as long as the therapist had access to the patient and could, by his attitude, administer the prescribed treatment. A change seemed indicated at times to give the Narcissistic patient a feeling that he was accomplishing something.

With the exception of a very few cases the results of the use of the Exercycle along these purely psychological lines are quite subjective, and the method itself is somewhat theoretical. It must be kept in mind that all patients are being exposed to many other types of treatments and many other therapists and no one can be certain as to which of these treatments brings about the desired effect. In some cases it could be the sum total and in others any one or combination of more than one. In many cases there has been no change whatever, which is to be expected, especially with schizophrenic patients.

In a few cases it appeared that the Exercycle made a clear cut contribution. For example, a young schizophrenic of the catatonic type AFTER HE HAD SHOWN SUFFICIENT IMPROVEMENT

TO BE DISCHARGED MHB FROM THE HOSPITAL stated that the Exercycle "relaxed him physically and mentally." He said it helped relieve his tension and did not produce fatigue. He "looked forward to going out (of the Ward) with the therapist for the change of atmosphere," and also that he "Got to like the therapist very much." He felt "peeved" when he was not taken out. This patient was extremely ill at the outset of treatment and was unable to carry on any type of activity other than sit on the Exercycle while it was driven by the motor.

In the above case it seems that the prescribed Narcissistic Gratifications with the noncommitant giving of "love" by the therapist was the correct treatment for the patient and that the treatment had a great amount of influence toward his recovery. It seems rather clear that the Exercycle played a part in the treatment when it is remembered that the patient COULD DO NO OTHER EXERCISE when in the acute phase of his illness. Thus, the Exercycle enabled the therapist to administer the proper treatment. It must be brought out here, though, that there were many other therapies being given this patient at the same time. The fact remains, however, that the Corrective Therapy was mentioned as a prominent factor by the patient himself.

This case is one of the exceptions but is used for the purpose of showing how one catatonic patient felt about the treatment during his acute illness. There are twenty other young catatonic patients now under treatment and have been for a long time, some of them pre-dating the case above, but who show little or no improvement. In as much as they are at present unable to engage in any other activity on a voluntary basis it seems that the Exercycle together with the proper milieu therapy remains the best contribution the Corrective Therapy Department can make toward the rehabilitation of these young veterans.

A more clear cut case that of a 58 year old Parkinson's Disease patient who spent most of his time in bed. He had been getting no other therapy, and the Exercycle was the only type of activity in which he could physically engage. Although the Parkinson's Disease symptoms appeared severe it was thought that his psychological maladjustment might be a major force.

Because of the fact that extreme physical dysfunction presented the immediate problem the Exercycle was used to provide an activity within the patient's capacity. Along with the Exercycle rides the therapist gave a great amount of attention and "love" along with suggestions that later the patient would be able to work at heavier exercises. After three months of this type of treatments the Exercycle was used only as a warm-up exercise preceding wall pulleys and later the patient was hitting the striking bag. His mental attitude improved to the extent that he was transferred to the Domiciliary Unit of the Center.

The Exercycle was used with success to activate a group of World War I patients among whom were a number of General Paresis cases who had a long hospital history. The section of the group who were given treatments on the Exercycle were "ward sitters" and showed signs of deterioration. Whereas the bulk of the Corrective Therapy Group from this ward participated in group swimming these patients would not enter into any activity.

Attitude therapy with the Exercycle activity (which they could do in spite of themselves) resulted in most of them voluntarily joining the swim group. Some patients were not graduated from the Exercycle due to contra-indication of swim therapy and some because the Exercycle constituted their hobby and activity interest which was the therapeutic aim prescribed for them.

One of the cases continued on the Exercycle presents an illustration of how the machine can be used to help meet the therapeutic aim of Relief of Guilt Feelings.

This case was diagnosed as Involutional Melancholia. He presented a picture of depression and was negativistic at all times with periods of actively hostile behavior. He did not want to ride the machine but with the prescribed attitude of firmness, matter-of-factness and no attention to the patient's protestations that he could not or would not get on the machine the treatments were begun. The exercise has been continued four times a week since April 14th along with the appropriate attitude of the ther-

apist for the Relief of Guilt Feelings.

The result of this treatment is that the patient's behavior on the ward has improved and he seems to get some relief from the treatment.

The general results noted are that the patients of this ward are more interested due to the fact that they are more alert, seem to be better satisfied because they feel that something is being done for them. Here again, it must be brought out that a great amount of attention was being given these patients by a highly trained and diligent nurse and head attendant. It was due to the nurse's determination to make use of all available facilities that Corrective Therapy was brought into the picture to begin with. When she first took over the ward a definite and concerted effort to bring about mental improvement was started. When the patients were dressed and taken out of the ward frequently and given intelligent attention they showed immediate response.

Other impressions could be written but the summation of them would leave the picture unchanged from the preceding pages. It is with the following conclusions that we summarize this report of our observations.

The exercycle is an excellent devise for providing an activity that any patient can perform. It is of scientific appearance and thus impresses the patients. Although it has been shown by other investigators that resistive work can be secured from the machine little was done along that line by our therapists. It was thought more important to follow along purely psychological lines. The attitude or milieu therapy was administered along with the Exercycle rides and with this combination we feel that we have a tangible basis for working with patients which heretofore, have been classified as those whose main treatment, in too many instances, was "Custodial Care."

REFERENCES

1. E. Corinne Fried, M.S., "Some Physiological Effects of Passive and Active Exercise." 11.
2. Human Engineering Associates, "An Analysis of the Exercycle based on a physiological study and some results of preliminary observations of its use in the clinic and research laboratory."
3. Exercycle Corporation, Fourteen Exercycle Exercises.
4. Neuropsychiatric Hospital, Veterans Administration Center TT10-1, Los Angeles, California, "Physician's Guide for Preparing Prescriptions in Medical Rehabilitation."

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The Role of Manual Arts Therapy in a Medical Rehabilitation Program

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1. DEFINITION AND OBJECTIVE

Manual Arts Therapy is one specific phase of the complete Physical Medicine Rehabilitation program which also includes Educational Therapy, Corrective Therapy, Occupational Therapy and Physical Therapy as members of a Medical Rehabilitation team. The Manual Arts Therapy program, under medical supervision, therapeutically utilizes at the pre-vocational level, projects of an industrial or trade nature into which a patient enters to explore the possibility and feasibility of continuing such activities as a post hospital vocation after further training. These purposeful activities are medically prescribed by physiatrists for the primary medical purpose of assisting in the restoration of patients to a state of health in the shortest possible time and of decreasing readmissions through individualized attention to the

practical demands of daily living.

It is important that these activities be regarded to a large extent as exploratory in nature rather than as complete preparation for vocational pursuits, although in certain cases they have served to renew interest or develop techniques previously established in vocations. This program therefore assists in reduction of the period of hospitalization as the patient becomes confident of his ability to perform in a definite field of work and looks forward to further vocational training and/or employment.

Physicians have found Manual Arts Therapy activities to be of practical aid in testing and developing physical and mental capacities for specific types of work and a valuable means of controlling development through progressive steps which correspond to the patient's various stages of recovery.

Conferences with the Vocational Advisor are held at frequent intervals and the aptitude of the patient, as reflected in his progress on shop projects, are discussed in order that every possible effort may be made to integrate shop instruction with the patient's vocational plans after discharge from the VA hospital. In certain cases patients will discover that the work for which they expected to train themselves after leaving the hospital is not to their liking or within their capacity; reassignment of activity can then be arranged until the proper selection has been made. The fact that a patient is making progress toward his means of future livelihood and is gaining confidence in his ability to perform in a chosen line of work is not merely rehabilitation from an economic standpoint but good therapy.

2. EXPLORING NEW FIELDS OF WORK

The Manual Arts Therapy section of the Physical Medicine Rehabilitation Service makes it possible for hospitalized veterans to investigate the possibilities of a new job and to select a field of work in which they are interested and for which they are physically as well as mentally equipped. This aspect of the Physical Medicine Rehabilitation Service is of critical importance for many severely disabled veterans.

For the majority of them, such an opportunity provides the first instance of concrete encouragement which they have encountered in the hospital. It permits them to make an actual start in an occupation of their choice and encourages them to overcome their physical disabilities in order that they may leave the hospital and enter into gainful employment. For certain types of patients it provides a reasonably accurate yardstick of the individual's physical capacity, tested under actual working conditions, with proper medical supervision to insure his safety while engaged in the particular activity. In addition, the patients will have been trained in various vocational techniques adapted to their disabilities which will be carried from the hospital into their civilian endeavors. These adapted techniques in the long run will reduce readmissions to the hospital which might ensue because of occupational aggravation of their disabilities.

These efforts for the rehabilitation of the many disabled veterans in our hospitals have received widespread support from major American industries. Officials of many of these industrial organizations are giving generously of their time, technical skills and advice, to further these efforts and to encourage the disabled veteran to tackle the job of constructive living once more.

As an example of the excellent cooperation that exists between outside industry and the Veterans Administration hospitals, the Garment Trades course, one of the many courses offered at the Veterans Hospital in the Bronx, has stimulated remarkable enthusiasm on the part of the patients. Through contact made by our volunteer instructor in this course, the International Ladies Garment Workers Union has recently approved a four months course including power machine operation, cutting, pattern layout, fitting, draping, hand finishing and commercial steam pressing.

Through the International Ladies Garment Workers Union, which has provided the Manual Arts Therapy Section with six new power sewing machines, two dummy models, a commercial steam pressing iron and cutting machine, it is contemplated that job placement and union cards will be made available to patients who have completed the approved course of instruction.

To date of this writing twenty-three patients have actively participated in this new program, the majority of whom have benefited either through employment in the Garment Industry, enrollment for further schooling, or upgrading in their present position.

3. FINANCIAL SAVINGS TO THE GOVERNMENT

The human aspects of such a program are evident; however, the economic side of this picture, as it is reflected in dollars and cents cost to the Government is important. Recently, thirty paraplegic veterans who had begun a watchmaking course while in Veterans Administration Hospitals were able to be discharged from the hospital and continue their training in the Bulova School of Watchmaking at Woodside, Long Island, N. Y. When that training is completed these men will be able to secure good positions in various phases of watchmaking and repair. If they had remained in our hospitals, the cost for their care for the next year alone would have been $131,000. It will cost $35,000 to complete their training at Bulova under Public Law 16. This represents an outright saving to the Government of some $96,000 during the next year alone. Such sums, multiplied many fold considering the vast numbers of disabled now in our hospitals, can amount to tremendous savings during the coming years. We owe it to our veterans to do everything possible to restore them to useful, satisfying lives; we likewise have a responsibility to the VA to do everything possible which will diminish the financial burden now imposed upon the Federal Government, a burden which, in the last analysis, is borne by the people of the country at large.

By contributing to the earlier recovery of patients and exploring their capacities for appropriate fields of employment, Manual Arts Therapy can save the Government and the people considerable expense. In addition to financial benefits, the veteran who has returned to his home and a job has benefited beyond measure physically, mentally and socially.

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Objective Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities

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I. PREFACE

The purpose of this project is to develop apparatus and objective techniques for measuring the strength of the affected muscle groups involved in orthopedic disabilities. Its accomplishment makes available to Army, Navy, and Veterans hospitals, to civilian general hospitals, to rehabilitation centers, and to corrective physical education departments in schools and colleges, objective measures for measuring gains in strength resulting from treatment of individuals with orthopedic disabilities. The unification of records and standardization of procedures for determining the extent of medical care thus made possible will provide more logical and standard methods of patient evaluation and will permit accurate interpretations of patient status to be made.

This project was initiated by Clarke and Peterson[1] while serving in the Physical Reconditioning Branch of the Army Air Forces Personnel Distribution Command during World War II. The tests were devised at the Army Air Force Convalescent Hospital, Bowman Field, Kentucky, and experimentation begun with non-disabled individuals at that post.

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Subsequently, the authors, under the supervision of orthopedic physicians, conducted a trial of the tests using patients with actual disabilities at the Army Air Forces convalescent hospitals located at Plattsburg, New York, and Miami Beach, Florida. However, it was not possible to determine the objectivity of these tests due to an insufficient number of patients with each disability at these hospitals. Also, the war ended, resulting in termination of the research.

The present phases of the investigation into orthopedic strength testing, performed under subsidy from the Office of Naval Research, consisted of the following:

1. Conduct of precision studies of the testing technique previously devised utilizing as subjects non-disabled college students.
2. Modification of the testing techniques in accordance with this additional experience in administering the tests.
3. Trial, under medical supervision, of the testing techniques on patients with orthopedic disabilities at a Naval hospital.

The balance of this report is devoted to a description of the instruments and apparatus utilized in the orthopedic strength testing, descriptions of the various test items, and a report of the results of the research completed under Navy contract.

II. AVAILABILITY OF ORTHOPEDIC STRENGTH TESTS

A review of the literature related to orthopedic strength tests indicates limited availability of objective techniques in this area. Daniels, Williams, and Worthingham[2] reviewed extensively and analyzed critically "manual" orthopedic strength tests proposed beween 1912 and 1946. Nearly all of these tests are dependent upon the subjective judgment of the examiner as he estimates the ability of the muscle to overcome gravity and outside force. The tests proposed by these authors also relied principally upon motion against gravity with various degrees of resistance applied manually by the examiner. The patient's strength status is graded in terms of "Normal," "Good," "Fair," "Poor," "Trace," "Zero," "Spasm," or "Contracture." Due to the lack of objective testing instruments and the large element of subjective judgment on the part of the examiner, these tests cannot be considered comparable to the objective techniques presented in this report. Their use, however, may still be necessary in types of disabilities not measurable with the new tests and in disabilities where only slight muscle contraction is possible or desirable.

In 1915, Lovett and Martin[3] proposed a spring balance test for measuring the strength of twenty-two muscle groups. In their tests, a sling was fastened to the extremity with the pull at right angle to the long axis of the limb. An assistant held the spring balance, fastened to the other end of the sling. The patient contracted the muscle being tested and held against the pull of the spring balance. The resistance registered represented the muscular strength.

The Chatillon spring scale was used by Elbel[4] in studying the short static strength of muscles. In these tests, a Chatillon spring balance with a capacity of 120 pounds was used. The pull was made by a rope and pulley arrangement, with one pulley fastened to the wall at the desired height and the other hooked to the immobile end of the balance. The subject exerted pull from the free end of the rope, attempting at all times to make the effort in a uniformly continuous manner. In their early experimentation, Clarke and Peterson found that the spring balance was too heavy and clumsy for orthopedic testing, that it was difficult to record initial tensions on the scale, that the spring permitted the subject to pass the angle of best effort at the height of the pull, and that the range of motion permitted in taking the test could not be precisely controlled.

The need for improved objective tests for use in measuring the strength of affected muscle groups involved in orthopedic disabilities is evident from this survey of the availability of such tests.

III. TESTING INSTRUMENTS AND APPARATUS

In devising the orthopedic tests presented herein, several different types of instruments were examined in order to discover the one most applicable for measuring muscle strength. After studying various torque wrenches, tensiomet-

ers, dynamometer, and spring scales, the tensiometer-like instrument was selected as having greatest potentialities for this purpose. The other pieces of apparatus needed in the testing were devised from readily available material.[5] Following are descriptions of the testing instruments and apparatus needed in administering the orthopedic strength test as finally constructed.

Tensiometer.[6]—The tensiometer is a small compact unit (4" x 4" x 1¼"), designed for testing the tension of aircraft control cables. Cable tension is determined by measuring the force needed to create offset in the cable between two set points. The cable tension may be converted directly into pounds on a prepared calibration chart attached to the inside of the cover of the tensiometer case.

The tensiometer is specifically designed to measure tension on an already taut cable. As a consequence, it was discovered that the instrument was not entirely accurate in measuring pulling force (the "up-pull") on a cable. This necessitated recalibration of the tensiometers used in this research, which was generously accomplished by the engineers of the Pacific Scientific Company, manufacturers of the tensiometer.

The initial work with the tensiometer was done with an instrument which measured cable tension up to 300 pounds. As this instrument would not measure accurately below 30 pounds, it was necessary to secure an additional, more sensitive tensiometer, from 5 to 100 pounds, for use with the smaller muscle groups and when testing muscles seriously weakened as the result of disabilities. Throughout the research, therefore, it was necessary to utilize two tensiometers: the heavier one when the strength is over 100 pounds; and the lighter, when the strength is under 30 pounds. Either instrument, of course, may be used when the strength is between 30 and 100 pounds. Actually, an instrument measuring to 200 pounds is adequate for the stronger pulls encountered.

Pulling Apparatus.—The pulling apparatus is homemade and consists of the following:

1. Cable: Two one-sixteenth inch extra flexible cables, preformed, 7 x 7, were utilized in this research. They are three feet six inches and six feet six inches long respectively. Other-sized cables may be used, with appropriate selection of riser and scoring table, as indicated in directions accompanying the tensiometer.

2. Loop: A small loop is formed at one end of each cable to permit attaching cable to hooks appropriately placed for the various tests. Small thimbles are necessary in this construction in order to avoid wear on the cable in testing. Splicing the cable junction and sweating in with solder completes strong construction of the loop.

3. Adjuster: An adjuster arrangement is constructed at the other end of each cable to permit easy and rapid adjustment in the length of the cable. This construction consists of (1) an adjuster bar: holes, large enough for the cable to pass through easily, were bored one-fourth inch from each end of a piece of metal 4 inches long (originally, this metal consisted of hollow aluminum tubing); (2) a cable: the cable was threaded through the holes in the tubing and through a "D" ring; the free end of the cable was knotted and soldered to prevent slipping through the hole.

In this research, the aluminum tubing used in the construction of the adjuster bar proved inadequate, as the metal was quickly worn away by the friction of the cable on the holes when the subject was pulling. The resultant slipping of the cable prevented accurate testing and might logically have proven injurious to the person taking the test, as the slipping often caused a sudden and unexpected jolt. After investigating different materials that would be more suitable for the adjuster bar, a regular 2 percent carbonated steel drill rod was selected. This metal was a great improvement over the tubing, but did not entirely solve the problem as some wear was evident around the holes of the adjuster bar after approximately 2,500 tests. Some cutting of the cable on the edges of the holes also occurred.

4. Strap: A pulling strap was attached by a "D" ring to the adjuster end of each cable for the purpose of placing around the patient's limb when pulling. The strap construction was as follows:

a. Double thickness of parachute webbing 2' 6" long and 2" wide, was formed

in a loop and stitched around a "D" ring.

b. The adjuster end of the cable was threaded through the ring.

c. A slide was made from the parachute webbing and affixed to the pulling strap to permit adjustment of the size of the loop and in order to keep the loop snug around the patient's limb.

Testing Table.—A padded testing table, approximately 6' 6" long, 2' 9" wide, and 2' 6" high, is needed for placing the patient in correct position for the various pulls. The table should be covered with some type of material that will prevent the subject from slipping. In this study, a regulation training-room (massage) plinth was used.

An additional testing table is necessary for the test, "extension of the leg at the knee joint," as the plinth is not high enough to permit passage of the cable under it at the proper angle. The supplementary table used in this study is illustrated in connection with Test No. 26. Any table high enough to permit the cable to pass under it at the desired angle may be utilized. It should be approximately 4 feet high and stable enough for the subject to sit on and be tested.

Supinator-Pronator Machine.—A supinator-pronator machine, as utilized in Tests 3 and 4, is required for testing supination and pronation strengths of the forearm. This instrument is standard gymnasium equipment mounted 2' 9" from the floor (measured from floor to center of axle) if the arm of the subject taking the test is to be rested on the regulation plinth. All friction parts are removed from the machine, so as to permit free movement of the handle.

A small hook placed at each end of the handle on the supinator-pronator machine is necessary in arranging the cable in position for the tests. The cable runs from the small hook on the handle to a large hook placed in the wall at the right or left of the machine.

Hooks.—A total of 47 four inch, open-eye hooks, which will withstand pulls up to 200 pounds, are screwed into the walls and ceiling. They are arranged to facilitate attaching the cable at the proper angle of pull for the various tests. A single overhead hook is also required for Test Nos. 20, 27, and 28.

Goniometer.—The goniometer is used for measuring the angles specified in the various tests. This instrument consists of a 180° protractor made from plexiglass with two arms, 18 inches long, attached. One of these arms is stationary and extends along the zero line; the other is movable, permitting rotation to the proper angle.

Testing Area.—The lay-out of the testing area for efficient administration of the tests, when only a corner of a room is utilized, is given. Some moving of the testing table in order to obtain the correct angles of pull for the various tests is necessary in this lay-out.

An improved arrangement would be to utilize a small room with the table in the center and duplicate sets of hooks installed on all sides. This setup would eliminate all shifting of the plinth and reduce to a minimum the moving of the subject when taking any number of different tests.

IV. TESTING INSTRUCTIONS

The following instructions for administering the orthopedic strength tests relate to their application to non-disabled individuals. Their special application to individuals who have orthopedic disabilities will be considered later.

GENERAL INSTRUCTIONS

1. For each test in the orthopedic strength measurement sequence, the anatomical position of the joint for the application of pulling force is specified. Every effort has been made to eliminate compensatory action of muscles not involved in the joint movement. Thus, the positions of other parts of the body are given and the "blocking" supplied by the tester is prescribed. Precautions to observe in administering the various tests also appear in connection with the test description.

2. The goniometer should be used for measuring joint angles specified in connection with each test. Instructions for using this instrument are contained in "Exercises to Increase Joint Movements," Supplement to A. F. Manual No. 24, **Instructor's Manual for Physical Retraining,** an Army Air Force publication.

3. The location of the strap on the patient's limb for each joint movement is so specified as to give best leverage for pulling.

4. The direction of pull (angle to cable and limb) is always 90°.
5. The cable should be taut when the patient is in proper position for the pull.
6. The cables should be stretched between two wall hooks when not in use in order to prevent them from becoming twisted and snarled.
7. The tester should adjust the joint being tested in such a way that the angle is approximately correct at the height of the pull.

DIRECTIONS FOR TENSIOMETER TESTING

1. Prepare tensiometer by mounting correct riser for the size of cable used for pulling (No. 1 riser, for 1/16", 3/32", and 1/8" cables).
2. Place subject in correct position for the joint movement to be tested. Use goniometer in arriving at correct angles for specified joint positions.
3. Mount cable-pulling apparatus assembly and place around patient's limb as directed. Adjust side so that pulling strap is snug. Tighten cable to taut position by moving adjuster bar.
4. Open trigger of the tensiometer and pass the cable between the two sectors and the rise. Close the trigger. Hold tensiometer in hand while testing. Precaution: Apply tensiometer to part of cable where there is a single strand only; testing on one of the double strands reduces record of pull.
5. The brake-lever rod should not be turned as it applies some pressure to the instrument and causes inaccurate testing. Turning the rod at the height of the pull in order to hold the reading position is permissible, although difficult. Careful observation of the pointer during the pull, visually noting its high point, was found to be the most desirable procedure.
6. Instruct subject to pull on cable and make as strong an effort as he can within his individual tolerance.
7. Take reading on dial of tensiometer.
8. Convert dial reading into pounds on calibration chart attached to inside cover of the tensiometer. Interpolate to determine pound force applied when dial readings are between those shown on the calibration chart. Interpolation below or above respective low and high "tension pounds" appearing on the chart, however, is inaccurate.

V. DESCRIPTION OF THE TESTS

This section of the report is devoted to a description of the orthopedic strength tests used in the study. The techniques utilized are, of course, patterned closely after those devised by Clarke and Peterson. However, some modifications are included as a result of this research, especially in prescribing the blocks applied by the tester to prevent the subject from using compensatory muscles in making his pull. Designations of the joint movements throughout the study are patterned after those appearing in Air Forces Manual No. 23, **Handbook of Recovery,** prepared at the Institute for Crippled and Disabled, New York, N. Y., and published by Training Aids Division Headquarters, Army Air Forces.

A. TESTS AT WRIST JOINT

1. Dorsal Flexion at Wrist Joint.

Starting Position:

(1) Patient sitting on chair; feet resting on floor.

(2) Arm adducted at shoulder at 180°; arm extended at shoulder to 180°.

(3) Elbow in 90° flexion; forearm in mid-prone and supine position.

(4) Wrist in mid-position of range of motion for dorsal and palmar flexion; forearm resting upon table; free arm on table bracing arm of wrist being tested.

Attachments:

(1) Center of strap around dorsum of hand 1" above the metacarpo-phalangeal joint.

(2) Cable attached to the wall facing palm of wrist being tested.

Direction of Pull: Parallel with horizontal plane.

Precautions:

(1) Prevent arm abduction at shoulder; tester block elbow close to side of subject.

(2) Prevent elevation of shoulder; tester block on top of shoulder.

2. Palmar Flexion at Wrist Joint.

Starting Position: Same as for test of "dorsal flexion at wrist joint."

Attachments:

(1) Center of strap around palm of

hand 1" above the metacarpo-phalangeal joint.

(2) Cable attached to wall facing dorsum of wrist being tested.

Direction of Pull: Parallel with horizontal plane.

Precautions:

(1) Prevent arm abduction at shoulder: tester block elbow close to side of subject.

(2) Prevent elevation of shoulder: tester block on top of shoulder.

3. Supination of Forearm.

Starting Position:

(1) Patient sitting on chair; feet resting on floor.

(2) Arm adducted at shoulder to 180°; arm extended at shoulder to 180°.

(3) Elbow in 90° flexion; forearm resting upon table at right angle with wall.

(4) Forearm in 100° pronation; hand grasping handle of pronator-supinator machine; free arm on thigh.

Attachments:

(1) Cable attached to wall at right of supinator-pronator machine.

(2) Attachment to supinator-pronator machine at lower part of handle for right hand; attachment at upper part of handle for left hand.

(3) In case cable is attached to wall at left side of pronator-supinator machine, these positions will be reversed.

Direction of Pull: Parallel with horizontal plane and wall.

Precautions:

(1) Prevent dorsal flexion at wrist.

(2) Prevent arm abduction at shoulder: tester block elbow close to side of subject.

(3) Prevent lateral flexion of spine: tester block across top of shoulder on side being tested.

4. Pronation of Forearm.

Starting Position:

(1) Same as for test of "supination of forearm," except forearm in 80° supination (instead of 100° pronation).

Attachments:

(1) Cable attached to wall at right of supinator-pronator machine.

(2) Attachment to supinator-pronator machine at upper part of handle for right hand; attachment at lower part of handle for left hand.

(3) In case cable is attached to wall at left side of pronator-supinator machine, these positions will be reversed.

Direction of Pull: Parallel with horizontal plane and wall.

Precautions:

(1) Prevent palmar flexion of wrist.

(2) Prevent arm abduction at shoulder: tester block elbow close to side of subject.

(3) Prevent lateral flexion of spine: tester block across top of shoulder on side being tested.

B. TESTS AT ELBOW JOINT

5, 6, 7. Flexion of Forearm at Elbow Joint (in three positions).

Starting Position:

(1) Patient in supine lying position, hips and knees flexed: feet resting on table.

(2) Arm adducted at shoulder to 180°; arm extended at shoulder to 180°; forearm in verticle plane.

(3) Elbow in 90° flexion.

(4) Forearm (test each position in turn): (a) In as much **supination** as possible. (b) In as much **pronation** as possible, (c) Midprone-supine position.

(5) Hand of free arm resting on chest.

Attachments:

(1) Center of strap around forearm midway between wrist and elbow joints.

(1) Cable hooked to wall at patient's feet.

Direction of Pull: Parallel with median line.

Precautions:

(1) Adjust forearm so that the elbow is in 90° flexion at height of pull.

(2) Prevent shoulder elevation by bracing with hand.

(3) Prevent raising elbow and abducting upper arm by bracing elbow to side and hooking thumb over arm at elbow joint.

8. Extension of Forearm at Elbow Joint.

Starting Position:

(1) Same as for text of "flexion of forearm at elbow joint," except elbow at 110° extension.

Attachments:
(1) Center of strap around forearm midway between wrist and elbow joints.
(2) Cable hooked to wall at patient's head.

Direction of Pull: Parallel with median line.

Precautions:
(1) Adjust forearm so that the elbow is in 90° flexion at height of pull.
(2) Prevent shoulder elevation by bracing with hand.
(3) Prevent raising elbow and abducting upper arm by bracing elbow to side and hooking thumb over arm at elbow joint.
(4) Subject should keep head in straight alignment with body.

C. TESTS AT SHOULDER JOINT

9. Adduction of Arm at Shoulder Joint.

Starting Position:
(1) Patient in supine lying position, hips and knees flexed; feet resting on table.
(2) Arm adducted at shoulder to 160°; arm extended at shoulder to 180°.
(3) Elbow in thrust position; forearm in midprone-supine position; free arm on chest.

Attachments:
(1) Center of strap around humerus midway between shoulder and elbow joints.
(2) Cable attached to wall at side of patient's arm being tested.

Direction of Pull: Parallel with horizontal plane.

Precautions
(1) Prevent elevation of shoulder.
(2) Tester should aid by bracing shoulder with hand.

10. Abduction of Arm at Shoulder Joint.

Starting Position:
(1) Patient in supine lying position, with body diagonally across table, hips and knees flexed; feet resting on table.
(2) Arm abducted at shoulder to 110°; arm extended at shoulder to 180°.
(3) Elbow in thrust position; forearm in midprone-supine position; free arm on chest.

Attachments:
(1) Center of strap around humerus between shoulder and elbow joints.
(2) Cable attached to wall at patient's feet; near leg crosses cable.

Direction of Pull: Parallel with horizontal plane.

Precaution: Prevent shoulder elevation.

11. Flexion of Arm at Shoulder Joint.

Starting Position:
(1) Patient in supine lying position, hips and knees flexed; feet resting on table.
(2) Arm adducted at shoulder at 180°; arm flexed at shoulder to 135°.
(3) Elbow in thrust position; free arm on chest.

Attachments:
(1) Center of strap around humerus midway between shoulder and elbow joints.
(2) Cable attached to wall at patient's feet.

Direction of Pull: Parallel to median line.

Precautions:
(1) Prevent shoulder elevation.
(2) Tester should aid by bracing shoulder with left hand, and guide patient's limb with right hand to prevent rotation.

12. Extension of Arm at Shoulder Joint.

Starting Position: Same as for test of "flexion of arm at shoulder joint."

Attachments: Same, except cable attached to wall at patient's head.

Direction of Pull: Parallel to median line.

Precautions:
(1) Prevent shoulder elevation.
(2) Tester should aid by bracing shoulder with hand.

13. Inward Rotation of Arm at Shoulder Joint.

Starting Position:
(1) Patient in supine lying position, hips and knees flexed; feet resting on table; free arm on chest.
(2) Arm adducted at shoulder to 180°; arm extended at shoulder to 180°.

(3) Elbow at 90° flexion; elbow supported by pad to bring upper arm into position parallel to table.

(4) Forearm in mid-prone supine position.

Attachments:

(1) Center of strap around forearm midway between elbow and wrist joints.

(2) Cable attached to wall at side of limb being tested.

Direction of Pull: Parallel with horizontal plane.

Precautions:

(1) Adjust forearm so that it is vertical at height of pull.

(2) Prevent "cupping" shoulder by bracing with hand.

(3) Prevent raising elbow and abducting upper arm by bracing elbow to side and hooking thumb over arm at elbow joint.

14. Outward Rotation of Arm at Shoulder Joint.

Starting Position: Same as for test of "inward rotation of arm at shoulder joint."

Attachments: Same, except cable attached to wall at opposite side of limb being tested.

Direction of Pull: Parallel with horizontal plane.

Precautions:

(1) Adjust forearm so that it is vertical at height of pull.

(2) Prevent "cupping" shoulder by bracing with hand.

(3) Prevent raising elbow and abducting upper arm by bracing elbow to side and hooking thumb over arm at elbow joint.

15. Flexion of Shoulder Girdle (Forward humeral depressor test).

Starting Position:

(1) Patient in supine lying position, hips and knees flexed; feet resting on table; free arm on chest.

(2) Arm adducted at shoulder to 180°; flexion of shoulder girdle to 45°.

(3) Elbow in thrust position.

Attachments:

(1) Center of strap around humerus midway between shoulder and elbow joints.

(2) Cable attached to wall at patient's feet.

Direction of Pull: Parallel with median line.

Precautions:

(1) Prevent hyperextension of trunk.

(2) Prevent shoulder elevation.

(3) Tester guide arm being tested by grasping hand or arm of subject.

16. Extension of Shoulder Girdle (Test for scapular rotators).

Starting Position: Same as test of "flexion of shoulder girdle."

Attachments: Same, except cable attached to wall at patient's head.

Direction of Pull: Parallel to median line.

Precautions:

(1) Prevent lifting shoulders off table.

(2) Tester guide arm being tested by grasping hand or arm of subject.

17. Upward Rotation of Scapula.

Starting Position:

(1) Patient in supine lying position, hips and knees flexed; feet resting on table; free arm on chest.

(2) Arm rotated to shoulder to 0°; arm upward rotated to 70°.

(3) Elbow at 90° flexion.

Attachments:

(1) Center of strap around humerus midway between shoulder and elbow joints.

(2) Cable attached to wall at patient's feet.

Direction of Pull: Parallel with horizontal plane.

Precaution: Prevent lifting shoulders off table.

18. Downward Rotation of Scapula.

Starting Position: Same as for test of "upward rotation of scapula."

Attachments: Same, except cable attached to wall at patient's head.

Direction of Pull: Parallel to horizontal plane.

Precaution: Prevent lifting shoulders off table.

D. TESTS AT HIP JOINT

19. Flexion of Thigh at Hip Joint.

Starting Position:
(1) Patient in supine lying position, leg not tested resting on table; arms folded on chest.
(2) Thigh in 120° flexion at hip joint; thigh adducted at hip joint to 180°.
(3) Knee flexed.
(4) Place pad under free knee for comfort.

Attachments:
(1) Strap around thigh, lower third between hip and knee joints.
(2) Cable attached to wall at patient's feet.

Direction of Pull: Parallel with median line.

Precautions:
(1) Prevent lifting of leg not being tested.
(2) Prevent raising hip of leg being tested.
(3) Tester should aid by bracing hip not being tested.

20. Extension of Thigh at Hip Joint.

Starting Position:
(1) Patient in sitting position on table, legs hanging free; arms folded on chest.
(2) Thigh in 70° flexion at hip joint; thigh adducted at hip joint to 180°.
(3) Knee flexed.
(4) Place pad under free knee for comfort.

Attachments:
(1) Strap around thigh, lower third between hip and knee joints.
(2) Cable attached to overhead hook.

Direction of Pull: Parallel with vertical plane.

Precautions:
(1) Prevent lifting buttocks: brace against free leg.
(2) The upper trunk should be maintained in a strictly erect position with no forward motion permitted.

21. Adduction of Thigh at Hip Joint:

Starting Position:
(1) Patient in supine lying position; legs outside edge of table, hanging free; arms folded on chest.
(2) Thigh adducted at hip joint to 160°; thigh in 180° extension at hip joint.
(3) Place pad under knee of leg being tested.

Attachments:
(1) Strap around thigh, lower third between hip and knee joints.
(2) Cable attached to wall at side of limb being tested.

Direction of Pull: Parallel with horizontal plane.

Precaution: Prevent flexion of thigh at hip joint: brace against free leg and hip.

22. Abduction of Thigh at Hip Joint.

Starting Position:
(1) Patient in supine lying position; legs outside edge of table, hanging free; arms folded on chest.
(2) Thigh adducted at hip joint to 180°; thigh in 180° extension at hip joint.
(3) Free thigh flexed at hip to allow cable clearance.
(4) Place pad under knee of leg being tested.

Attachments:
(1) Strap around thigh, lower third between hip and knee joints.
(2) Cable attached to opposite wall from limb being tested.

Direction of Pull: Parallel with horizontal plane.

Precaution: Prevent flexion of thigh at hip joint; brace against hip being tested; prevent tilting of pelvis.

23. Inward Rotation of Thigh at Hip Joint.

Starting Position:
(1) Patient in sitting position on table, legs hanging free; arms folded on chest.
(2) Thigh in 90° flexion at hip joint; thigh adducted at hip joint to 180°.
(3) Knee in 90° flexion; padded support under knee.

Attachments:
(1) Center of strap around leg 4" above ankle joint.
(2) Cable attached to wall on side away from limb being tested.

Direction of Pull: Parallel with horizontal plane and at right angles to median line.

Precautions:
(1) Prevent adduction and flexion of thigh at hip joint; tester should aid by bracing thigh with hands.
(2) Prevent eversion at ankle joint.

24. Outward Rotation of Thigh at Hip Joint.

Starting Position: Same as for test of "inward rotation of thigh at hip joint."

Attachments: Same, except cable attached to wall on side of limb being tested.

Direction of Pull: Parallel with horizontal plane, and at righ angles to median line.

Precautions:
(1) Prevent abduction and flexion of thigh at hip joint; tester should aid by bracing thigh with hands.
(2) Prevent inversion at ankle joint.

E. TESTS AT KNEE JOINT

25. Flexion of Leg at Knee Joint.

Starting Position:
(1) Patient in prone lying position; arms folded above head.
(2) Thigh adducted at hip to 180°.
(3) Knee in 135° extension.

Attachments:
(1) Center of strap around leg midway between knee and ankle joints.
(2) Cable attached to wall at patient's feet.

Direction of Pull: Parallel with median line.

Precautions:
(1) Prevent lifting thigh and hips from table: brace hips with hands.
(2) Prevent inward or outward rotation at hip joint.

26. Extension of Leg at Knee Joint.

Starting Position:
(1) Patient in sitting position, legs hanging free; arms folded on chest.
(2) Thigh adducted at hip to 180°.
(3) Knee in 135° extension; padded support under knee.

Attachments:
(1) Center of strap around leg midway between knee and ankle joints.
(2) Cable attached to wall in back of patient.

Direction of Pull: Parallel with median line.

Precautions:
(1) Prevent lifting of buttocks: brace free thigh and hip.
(2) Prevent inward and outward rotation at hip joint.

F. TESTS AT ANKLE JOINT

27. Dorsal Flexion at Ankle Joint.

Starting Position:
(1) Patient in prone lying position; arms resting on table at side of head.
(2) Thigh adducted at hip joint to 180°; thigh in 180° extension at hip joint.
(3) Knee in 90° flexion.
(4) Ankle in 90° dorsal flexion; ankle in midposition of inversion and eversion.

Attachments:
(1) Center of strap around foot 1" above metatarsal-phalangeal joints.
(2) Cable attached overhead.

Direction of Pull: Parallel with vertical plane.

Precautions:
(1) Prevent inversion at ankle joint.
(2) Prevent flexion at metatarsal-phalangeal joints.
(3) Prevent raising knee; tester should aid by holding thigh against table.

28. Plantar Flexion at Ankle Joint.

Starting Position:
(1) Patient in sitting position on table, legs hanging free; arms folded on chest.
(2) Thigh adducted at hip joint to 180°.
(3) Knee in 90° flexion; padded support under knee.
(4) Ankle in 90° plantar flexion; ankle in midposition of inversion and eversion.

Attachments:
(1) Center of strap around foot above metatarsal-phalangeal joint.
(2) Cable attached to ceiling.

Direction of Pull: Parallel with vertical plane.

Precautions:
(1) Prevent lifting of buttocks (eliminate hip extensors).

(2) Prevent inversion or eversion at ankle joint.

(3) Prevent extension of metatarsal-phalangeal joints.

(4) Tester brace knee and leg to hold in proper position.

VI. PRECISION STUDY

The purpose of this phase of the research was to determine the objectivity coefficient[7] for each of the 28 orthopedic strength tests, as applied to non-disabled male students at Springfield College. Non-disabled subjects were used in the precision study for the following reasons:

1. In order to avoid such uncontrollable variables as pain, fear of injury, and general hesitancy on the part of patients to pull with an injured limb.
2. Because of reluctance to utilize patients in an experimental situation involving physical effort to injured parts.

As the precision with which the testing techniques can be applied was established on non-disabled subjects, it should be pointed out that similar results would not necessarily occur with patients unless they had been thoroughly oriented and accustomed to the tests. Application of the tests to patients, of course, should be done only under medical supervision.

The precision study was conducted by two graduate students at Springfield College.[8] Each of the 28 tests was administered separately by the two investigators to 64 students chosen at random. The tests were given in groups of six to eight, selected in relation to minimum movement of the testing table and other adjustments in the administration of the tests.

Before any test scores were recorded, the investigators were carefully instructed in the proper techniques of administering the tests, after which demonstrations and practices were conducted. This instruction period provided appropriate skill in testing and experience with the tests before actually conducting the precision study. The subjects, however, did not receive practice in the tests prior to taking them.

For each group of tests, the same subjects were tested on the same day by both examiners independently. The tester not actually giving the test made the tensiometer readings and recorded them on a separate record form. Neither the tester nor the subject was permitted to see or hear each score as it was recorded. This precaution was taken both to eliminate the possibility of collaboration between the investigators and to prevent the motivation of "beating his score" on the part of the subject when taking the tests a second time.

Following the testing, a product-moment coefficient of correlation was computed between the scores obtained by the two testers on the 64 subjects for each of the 28 orthopedic strength tests. The resultant correlations appear in Table I, and are herein known as objectivity coefficients. It will be noted that 22 of the tests had objectivity coefficients of .92 and above; 12 of these were between .95 and .97. Six of the tests had coefficients lower than .90, but no test was below .84.

As .90 is the accepted standard indicating desirable objectivity and as tests with coefficients as low as .80 may be used for individual measurement, none of the 28 tests studied should be considered sufficiently unsatisfactory to warrant elimination from the battery. In order to double check the results obtained on the tests with objectivity coefficients below .90, however, precision studies were subsequently repeated on these six tests by two different investigators. The tests themselves were re-studied and appropriate changes made in their techniques. The two investigators* also practiced administering the tests until they had confidence in their ability to give them. Very satisfactory results were obtained as shown in Table II.

As the result of the re-study of these six tests, some modifications in testing techniques were found desirable. Such changes dealt primarily with specification of additional body blocks and listing additional precautions to prevent the subject from utilizing muscle groups other than those being tested in making his pull. Tests 5 and 8, flexion and extension of forearm at elbow joint, gave greatest difficulty due to the subject's desire to bring extraneous muscles into play. Eventually, however, these tests

*Theodore L. Bailey and Charles B. Neff, graduate assistants at Springfield College.

TABLE I

Objectivity Coefficients Obtained by Mullen and Parker on the Twenty-eight Orthopedic Strength Tests

Classification	Name of Test	Objectivity Coefficients	
Tests at Wrist Joint	1. Dorsal Flexion at Wrist Joint	.86	.95*
	2. Palmar Flexion at Wrist Joint	.93	
	3. Supination of Forearm	.91	
	4. Pronation of Forearm	.95	
Tests at Elbow Joint	5. Flexion of Forearm at Elbow Joint (Midprone-Supine Position)	.84	.96*
	6. Flexion of Forearm at Elbow Joint (In as much Supination as possible)	.92	
	7. Flexion of Forearm at Elbow Joint (In as much Pronation as possible)	.95	
	8. Extension of Forearm at Elbow Joint	.88	.94*
Tests of Shoulder Joint	9. Adduction of Arm at Shoulder Joint	.94	
	16. Abduction of Arm at Shoulder Joint	.94	
	11. Flexion of Arm at Shoulder Joint	.94	
	12. Extension of Arm at Shoulder Joint	.97	
	13. Inward Rotation of Arm at Shoulder Joint	.84	.94*
	14. Outward Rotation of Arm at Shoulder Joint	.89	.93*
	15. Flexion of Shoulder Girdle	.94	
	16. Extension of Shoulder Girdle	.96	
	17. Upward Rotation of Scapula	.94	
	18. Downward Rotation of Scapula	.97	
Tests at Hip Joint	19. Flexion of Thigh at Hip Joint	.92	
	20. Extension of Thigh at Hip Joint	.86	.93*
	21. Adduction of Thigh at Hip Joint	.97	
	22. Abduction of Thigh at Hip Joint	.96	
	23. Inward Rotation of Thigh at Hip Joint	.95	
	24. Outward Rotation of Thigh at Hip Joint	.95	
Tests at Knee Joint	25. Flexion of Leg at Knee Joint	.97	
	26. Extension of Leg at Knee Joint	.94	
Tests at Ankle Joint	27. Dorsal Flexion at Ankle Joint	.95	
	28. Plantar Flexion at Ankle Joint	.96	

*Obtained on revised form of test.

TABLE II

Objectivity Coefficients Obtained by Bailey and Neff for Revised Form of Six Tests Found Below .90 in Initial Study

Name of Test	Objectivity Initial Tests	Coefficients Revised Tests
1. Dorsal Flexion at Wrist Joint	.86	.95
5. Flexion of Forearm at Elbow Joint (Midprone-Supine position)	.84	.96
8. Extension of Forearm at Elbow Joint	.88	.94
13. Inward Rotation of Arm at Shoulder Joint	.84	.94
14. Outward Rotation of Arm at Shoulder Joint	.89	.93
20. Extension of Thigh at Hip Joint	.86	.93

were modified so as to permit accurate testing when the techniques are carefully applied. The changes resulting from this additional study of the six tests have been incorporated into the test descriptions previously given.

Without doubt, one of the greatest difficulties in administering this type of test is to isolate the **effect** of the muscles controlling the specific joint movements and to eliminate the **effect** to compensatory muscles. Considerable care, therefore, must be taken in the use of the tests to follow the specific instructions for the various testing techniques, especially as they pertain to the precautions listed and the blocks specified.

A number of important observations were made by the various investigators in conducting the precision study which will aid materially in the availability and cost of testing equipment, in the durability of testing instruments, and in the ease of test administration. Proposals based on their findings are included among the recommendations made at the end of this report.

VII. TRIAL OF TESTS ON ORTHOPEDIC PATIENTS

Following the improvement of testing techniques and the precision study, arrangements were made to try the orthopedic strength tests on patients with orthopedic disabilities at the U. S. Naval Hospital, Chelsea, Mass. The purpose of this trial was to determine the appropriateness of the tests when applied to individuals with actual disabilities and to discover additional modifications of testing techniques necessary under these conditions.

The hospital trial was conducted from August 11-15, 1947, by the writer with the assistance of the graduate students who conducted the precision study.*

The procedure followed in this phase of the study was to try out the tests on as many patients as were available and who were, in the opinion of the physicians, sufficiently far along in their recovery so as to suffer no ill effects from the exertion attendant upon taking the tests. Fortunately, the distribution of patients at the Chelsea Naval Hospial at the time of the trial was such as to provide subjects for each of the joint movements involved. In testing, of course, each patient was given only those tests which applied to his particular disability. Corresponding tests with the uninjured limb were also given for purposes of comparison. The trial at the Chelsea hospital was particularly fortunate in that the patients were accustomed to pulling through the use of heavy resistive exercises in their physical rehabilitation program.

The disabilities encountered in the hospital trial included the following: bone-pegging operations, gunshot wounds, fractures with both open and closed reductions, arthritis, arthrotemies, bursitis, and ruptured intervertebral disk. Patient status ranged from those in the early stages of convalescence to those who were ready to return to duty. Two case studies only are given for illustrative purposes, as follows:

Case No. 2: Gunshot wound in left forearm, October, 1946: compound fracture of upper radius bone; bone plates used. Bone graft operation done, February, 1947; cast removed three months later; physiotherapy and physical rehabilitation begun. Patient also had medium and radial nerve envolvements of left forearm; progress satisfactory.

Tests	Injured	Uninjured
Flexion of forearm at elbow joint (mid-prone-supine)	13	41
Flexion of forearm at elbow (supination)	10	36
Flexion of forearm at elbow (pronation)	6	30
Extension of forearm at elbow joint	19	41

Case No. 7: Head-on truck collision: multiple fractures of face and pelvis: pelvis fracture extending into acetabulum on left side; became ambulatory on crutches two months before trial. Gradual weight-bearing one month later; at time of trial was walking on crutches without pain; full range of motion in left hip; muscles of left thigh partially atrophied. Treatment now consisting of extensive physiotherapy and physical rehabilitation.

Tests	Injured	Uninjured
Flexion of thigh at hip joint	31	55
Extension of thigh at hip joint	43	67
Adduction of thigh at hip joint	13	31
Abduction of thigh at hip joint	31	33
Inward rotation of thigh at hip joint	19	26
Outward rotation of thigh at hip joint	16	26

In conducting the trial, the appropriateness of the various tests when applied to patients recovering from disabilities was determined by observation. In each instance, a physician at the hospital checked the test application and made suggestions when they appeared desirable. An examination of each patient on the day following his testing to discover if undesirable after-effects were present aided in forming a sound evaluation of the procedures.

The results of the trial of the strength tests upon patients with orthopedic disabilities at the Chelsea Naval Hospital were considered satisfactory. In general, they coincided well with medical opinion of patient status. Physicians, technicians, and patients were definitely interested in the objective scores thus made possible. Dr. Haslam, one of the supervising orthopedic physicians at Chelsea Hospi-

*George D. Mullen and Harlow A. Parker. The trial was supervised by the orthopedic physicians at the Chelsea Hospital, Comdr. Edward T. Haslam, MC, USN, in charge. In addition to Comdr. Haslam, acknowledgements for this supervision are made to Lieut. (jg) Frank C. Doyle, MC, USNR, and Lieut. (jg) Robert D. Heath, MC, USNR. Miss Eileen F. Haydock, Reg. PT, also assisted with the testing.

tal, rendered his opinion in a formal letter, which contained the following significant points:

1. No complications or sequaella occurred which was attributable to the testing. The physicians believed that, if such had been the case, it would not mean that the tests were unsuitable but rather that the patients were not ready for strong exertion.

2. In general, the test results were consistent with the impressions of the physicians and with the results previously noted by measurements and by the amount of weight the patient could lift.

3. The tensiometer-type of testing has an advantage in that the pull is constant for a long-enough period to permit the examiner, by inspection and palpation, to ascertain which tendons are in a state of tension, and thus aid in the interpretation of the results.

4. The tests might prove to be of value in deciding whether muscle strength was adequate to permit satisfactory arthroplasty, after a series had been followed with these tests and the muscle strength checked with the results obtained following surgery.

5. The tests could be used advantageously in following patients, who had been put on intensive physical rehabilitation, as a means of determining progress and need of revision of their exercises.

6. The test readings are unknown to the patient while taking the test, which would not be true were he lifting known weights, thus making it difficult for him to produce wilfully low readings which would be consistent from day to day or week to week. Also, patients wishing to appear more fully recuperated than is actually the case could be easily detected.[9]

As a result of the testing trial, the following directions were found appropriate when applying the tests to patients and are given in addition to the testing instructions appearing in Section IV of this report:

1. Strength testing of affected muscle groups involved in orthopedic disabilities should be accomplished under supervision of appropriate medical authority. In medical practice, of course, such tests as these should be considered as supplementary measures to other medically prescribed means of evaluation.

2. Where tenderness in the joint area is present and the patient experiences some pain in pulling, he should be instructed not to pull beyond the force he can apply comfortably. In such instances, the full strength of the muscle group is not measured; but rather, the patient's application of strength only is recorded.

3. If the range of motion in the patient's injured limb is limited, thus preventing assumption of prescribed joint angles, the tester should make necessary allowances until it improves sufficiently to permit proper positions to be taken.

4. Changes in the position of the strap applied to the patient's limb should be made by the tester if the prescribed position is uncomfortable in individual cases.

5. Where a large number of tests are proposed around a single joint, which is particularly true of the shoulder, it is desirable to either select the specific tests needed or give all the tests at the first testing period and subsequently repeat only those showing deficiencies. In some instances, too, it may be advisable to spread the testing over more than one day.

VIII. CONCLUSIONS

This research project should be considered a first exploratory effort into objective testing with the apparatus and techniques herein described. The evidence presented indicates that the tests can be given accurately when measuring the strength of muscles controlling the 28 joint movements studied, and can be used on patients when administered under medical supervision.

However, improvements in the apparatus and techniques are possible. Plans have been made and research started to study the effectiveness of different joint angles and strap positions for the various tests. Tests for joint movements not included in this study will be devised, norms constructed, and the testing apparatus standardized and made readily available.

REFERENCES

1. H. Harrison Clarke and Kjell J. Peterson. Strength tests of affected muscle groups involved in orthopedic disabilities. Unpublished manuscript, Springfield College, Springfield, Mass., 1945.

2. Lucile Daniels, Marian Williams, and Catherine Worthingham. "Muscle Testing." Philadelphia: W. B. Saunders Company, 1947, p. 9-13.
3. R. W. Lovett and E. C. Martin. Certain aspects of infantile paralysis with a description of a method of muscle testing. Journal of American Medical Association, 66:732-733, 1916.
4. Edwin R. Elbel. A study in short static strength of muscles. Unpublished master's thesis, Springfield College, Springfield, Mass., 1928, p. 30.
5. Clarke and Peterson, op. cit.
6. Manufactured by the Pacific Scientific Co., Inc., 1430 Grande Vista Avenue, Los Angeles, Calif.
7. In physical testing, a measure is considered objective if two or more different testers, using the same instrument and applying the same techniques, secure similar results.
8. George D. Mullen and Harlow A. Parker. A study to determine the objectivity of orthopedic strength tests as applied to non-disabled college men. Unpublished master's thesis, Springfield College, Springfield, Mass., 1947.
9. A detailed report of the 19 case studies and the complete letter written by Dr. Haslam appear in the report of this research submitted to the Office of Naval Research and deposited in the Springfield College Library.

Let's Talk It Over

What they have lost is in the past. Our job is to help them make a future with what they have left.

During the past seven months the circulation of your Journal has more than doubled. It has been and will continue to be our policy to present articles of interest to the entire field of Rehabilitation.

The Doctors, Educators, Therapists, Nurses and Statisticians, plus the ever important patient, are the ones responsible for the whole Rehabilitation program and the exchange of your ideas through the medium of your official publication, **The Physical & Mental Rehabilitation Journal**, is the one positive means to disseminate new techniques and statistics throughout the country so that all in the field of Rehabilitation may profit from your work. Send in your articles and if they are approved by our Editorial Board we will see that your contributions are published.

If you are experiencing any difficulty in securing your **Journal** I would suggest that you check with your Communications and Records Section of your station to determine if delivery is being made. It seems to be the rule at some hospitals that no personal mail can be delivered to the personnel unless they reside on the station. As magazines and periodicals are not remailable unless additional postage is furnished it is believed that this may account for some of our **Journals** going astray. I believe it advisable to send us your home address, thereby avoiding any possibility of error.

From all pre-convention news received so far our Third Annual Convention and Exhibit, to be held at the Hotel New Yorker in New York City, May 18-21, 1949, should be one of the best scientific conventions to be held in years. Some of the most outstanding medical and educational authorities in the field of Rehabilitation will present papers at the convention. From the agenda so far outlined this convention should be a must for all of us who work in the Rehabilitation field regardless of our affiliations or sections of Rehabilitation we represent. For further information contact convention chairman, Leo Berner, Chief Corrective Therapy, Veterans Administration Hospital, Bronx 63, New York.

Your Editor has attended many meetings during the past year. Some were strictly Rehabilitation, some were of allied groups and others of combination groups, all of whom were working either directly or indirectly for the complete Rehabilitation of the patient. It has been exceedingly gratifying to see the separate Rehabilitation sections getting their heads together, exchanging ideas, working as one team for the one thing that justifies our existance, the patient. Only occasionally has it been my misfortune to meet a therapist, in one or another field of Rehabilitation, who thinks his particular activity is the only one actually doing anything for the patient. Fortunately the patient does not have to depend on this type of therapist for his Rehabilitation program. It has been my observation that a therapist who has time to criticize the work or worth of other allied groups isn't doing his or her work very thoroughly. When these few die-hards realize the importance of team work and that no one section of the team can do the complete job alone then and then only will they function as members of the whole program.

We must cooperate to rehabilitate.

The Therapeutic Section of the American Association for Health, Physical Education and Recreation is planning an expanded program for the annual meeting in Boston, 18-23 April, 1949. Dr. C. W. Morgan, Office of The Surgeon General, Department of the Army, is Chairman of the Section and is arranging the activities.

Tuesday, 19 April, 1949, 9:00 A.M.-4:30 P.M.—Visit to Physical Medicine Rehabilitation Service,

Cushing Veterans Hospital, Framingham, Massachusetts.

Thursday, 21 April, 1949, 12:30 P.M.—Therapeutic Section Luncheon.

Friday, 22 April, 1949, 11:00 A.M.—12:30 P.M. — Therapeutic Section Meeting. Subject: "The Treatment of Athletic Injuries."

The following is a detailed program of the visit to Cushing Veterans Hospital, Framingham, Massachusetts, 19 April, 1949:

9:00-9:10 A.M.—Assembly.

9:10-9:25 A.M.—Address by the Manager.

9:25-10:10 A.M.—Physical Medicine Rehabilitation at Cushing VA Hospital, Chief, Physical Medicine Rehabilitation Service.

10:10-10:30 A.M. — Discussion opened by Executive Assistant, Physical Medicine Rehabilitation Service.

10:30-12:00 A.M. — Visit to Clinics of Occupational, Manual Arts, and Educational Therapy Departments.

12:00-1:00 P.M.—Lunch period.

1:00-1:30 P.M.—Hospital Recreation, Chief, Special Services.

1:30-1:40 P.M. — Discussion opened by Assistant Chief, Special Services.

1:40-2:10 P.M. — Corrective Therapy, Chief, Corrective Therapy Department.

2:10-2:20 P.M. — Discussion opened by Executive Assistant, Physical Medicine Rehabilitation Service.

2:20-4:00 P.M.—Visit to clinic of Corrective and Physical Therapy Departments.

4:00-4:30 P.M.—Question and answer period—opened by Executive Assistant, Physical Medicine Rehabilitation Service.

The Physical & Mental Rehabilitation Association will be officially represented by our President and it is hoped that all of our members who possibly can will attend this session of the A. A. H. P. E. R.

Even though the circulation of your **Journal** has more than doubled in the past seven months and new members keep coming in, it is amazing to see how many men working in our field have failed to join the organization that is doing so much to gain national recognition for them.

Past experiences by other groups have proved the necessity for a strong organization to represent them through proper channels to the right people, at the right time and it behooves all of us in the Rehabilitation field to support our association by joining up and paying our dues promptly. Let's make 1949 a banner year. Pay your dues now and sign up a new member!